

OBJECTIVES: 1) To determine the growth rate for individual clams (both species), mussels (both species), and vestimentiferans (both species) in a range of natural habitat conditions; 2) to determine if any external tube or shell rings have a yearly periodicity which would allow a simple aging of individuals of that species; 3) to determine the habitat requirements for both species of clams, mussels, and vestimentiferans; 4) to determine density, species composition, and size frequency of mussels in mussel beds for accurate estimations of community methanotrophy and primary production; 5) to determine rates of natural recruitment

of vestimentiferan larvae, and if spawning/recruitment is seasonal or relatively constant; 6) to determine maximal rates of growth for juvenile vestimentiferans; 7) to calculate primary production rates for animal aggregations and entire communities; 8) to determine ages

of individual animals and entire communities; 9) to continue ongoing laboratory-based studies of physiology, biochemistry, and taxonomy of the symbiont-containing fauna and the ~ symbionts.

METHODS: In order to obtain water samples relevant to the physiology of the hydrocarbon-seep animals (and the symbionts upon which they rely) we have designed samplers which take small volume samples (a few mils) from very close proximity to the animals and from the shallow ~ pore waters in the substrates where they live. All of the experimental animals will have the concentrations of sulfide, oxygen, methane, and carbon dioxide in the relevant pools of water in their habitat determined. Tube growth in vestimentiferans will be determined in situ by banding the worm tubes, documenting the position of the bands, and returning in subsequent years to measure incremental growth. Water samples will be taken from among their plumes and in substrates between their tubes. Mytilid shell growth will be determined for marked animals deployed at their site of collection for 2-3 one year periods. Water samples will be taken from adjacent to their siphons and below their feet. Growth rates in a range of natural ~ habitats will be determined for each of the above species. Density, size, and species composition of mussels in mussel beds will also be determined. Vesicomyid clam shell growth ~ will be determined for clams deployed into corrals for 2-3 one year periods. Clam corrals ~ will be deployed in a variety of likely habitats and the chemistry of the pools of interstitial water available in the corrals determined. The tube or shell growth rates measured for each species will be related to tissue growth by determining the relation between tube or shell dimensions and tissue mass. Rates of recruitment of vestimentiferan larvae to natural and artificial substrates will be determined through deployment of settlement surfaces in defined habitats for one year periods. Laboratory studies will address questions of respiration, methane, and sulfide consumption rates, nitrogen sources, taxonomy, symbiont physiology, larval development, and host-symbiont interactions using standard techniques.

RATIONALE: This proposal directly addresses two primary NURP research objectives: Productivity and habitat characteristics. The work proposed here will allow determinations of individual and community growth rates (in terms of biomass), determination of rates of community primary production, calculation of rates of methane oxidation by entire mussel communities, and accurate estimations of age for seep species and communities. The watt sampling devices developed and under development by my laboratory will allow the first physiologically relevant description of the habitat occupied by the mussels (both species), tube worms (both species), and clams (both species) at these sites. The sites under study are hydrocarbon-seep communities, which, along with hydrothermal vent sites, are a NOAA priority. Furthermore, these particular communities are the first and only ecological system within the Exclusive Economic Zone (EEZ) to be protected by regulations governing mineral development (gas and oil) beyond the continental shelf. In addition to providing the most complete description of growth and production for any vent or seep community this study will be directly comparable to other, more limited similar studies of deep-seep and hydrothermal vent communities and animals.

ACCOMPLISHMENTS: The 1992 mission was fully successful with respect to our modified (for less dive time) research goals. Most of our tangible results were successful collections of marked animals, deployments of marked animals, banding off tubeworms, etc.

Initial results indicate that: 1) the tubeworms here grow extremely slowly and mature individuals are likely in excess of 100 years old (perhaps much older). This is in stark contrast to established views. They produce about 1 "ring" on their tube each year. 2) We are working on several very different types of mussel communities with different age animals, associated fauna, and water chemistry. 3) The mussels grow quickly when young (as fast as intertidal mussel_) and quite slowly when mature. Mature individuals are between 50 and 100 years old. 4) Due to the density of the mussels and the abundance of methane, some of the communities consume methane at higher rates than any biological community on the planet (on a per area basis). 5) We can now collect and maintain alive the vesicomyid clams, "C. ponderosa." This will allow in-situ studies in future years.

BENEFITS: Much of the data collected on this mission will be combined with past data and included in a book currently under contract to CRC press. Its tentative title is "Chemosynthetic Communities in the Gulf of Mexico" which will be edited by myself and Dr. J. Brooks. All chapters are due in March. Primary authors of 5 chapters (and co-authors of ~ more) were on board. Mussel growth studies to date will be included in a masters thesis (1 Nix) and submitted for publication to "Natural History" by early winter.

Tubeworm growth and condition studies to date will be included in a masters thesis (M. Simpkins) and submitted to Nature in early winter. Both are graduating in January. Water sampling data will be included in each and constitute a full chapter in the book. Several on-going laboratory studies of the mussels should be completed this year using the ~. collections, but publication plans are premature. The brine pool studies will not mature sufficiently for publication until the in-situ studies are collected next year and some collections replicated. Similarly, the larval settlement studies cannot be analyzed until collected next year.

NURC/UNCW